Mexico City Megacity 2006 - Overview

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MEGACITIES AND MINI-MEGACITIES MAJOR SOURCES OF AEROSOLS AND GREENHOUSE GASES

THESE SOURCES WILL BE CHANGING OVER TIME AS THE CITIES DEVELOP AND THE TECHNOLOGIES EVOLVE

CARBONACEOUS AEROSOLS (ORGANIC & BLACK CARBON)

SULFATE, NITRATE – *FOSSIL FUEL COMBUSTION*

BLACK CARBON – *DIESEL AND TWO-CYCLE ENGINES, ETC.*

SECONDARY ORGANIC AEROSOLS – *FOSSIL AND BIOGENIC*

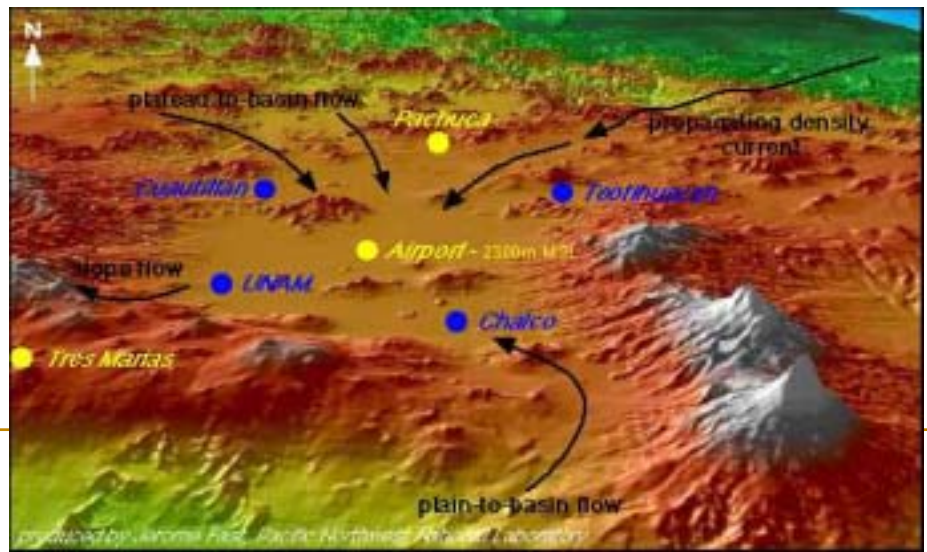
NEED TO BETTER CHARACTERIZE THE EMISSIONS

AND THEIR PROPERTIES (SIZE, ETC.)

TARGET OF OPPORTUNITY - MEXICO CITY

- 2ND LARGEST MEGACITY

- LARGEST MEGACITY IN NORTH AMERICA
- BASIN METEOROLOGY - COMPLEX TERRAIN
- INFRASTRUCTURE CONNECTIONS!
- SIZE REASONABLE FOR AIRCRAFT AND GROUND STUDY
- PRELIMINARY GROUND FIELD STUDIES – **1997 & 2003**



Mexico City 1997

LOTS OF AEROSOLS – ON A DAILY BASIS!

> 50 μg/m^3 PM-2.5

50% Organic and Black Carbon (Soot)

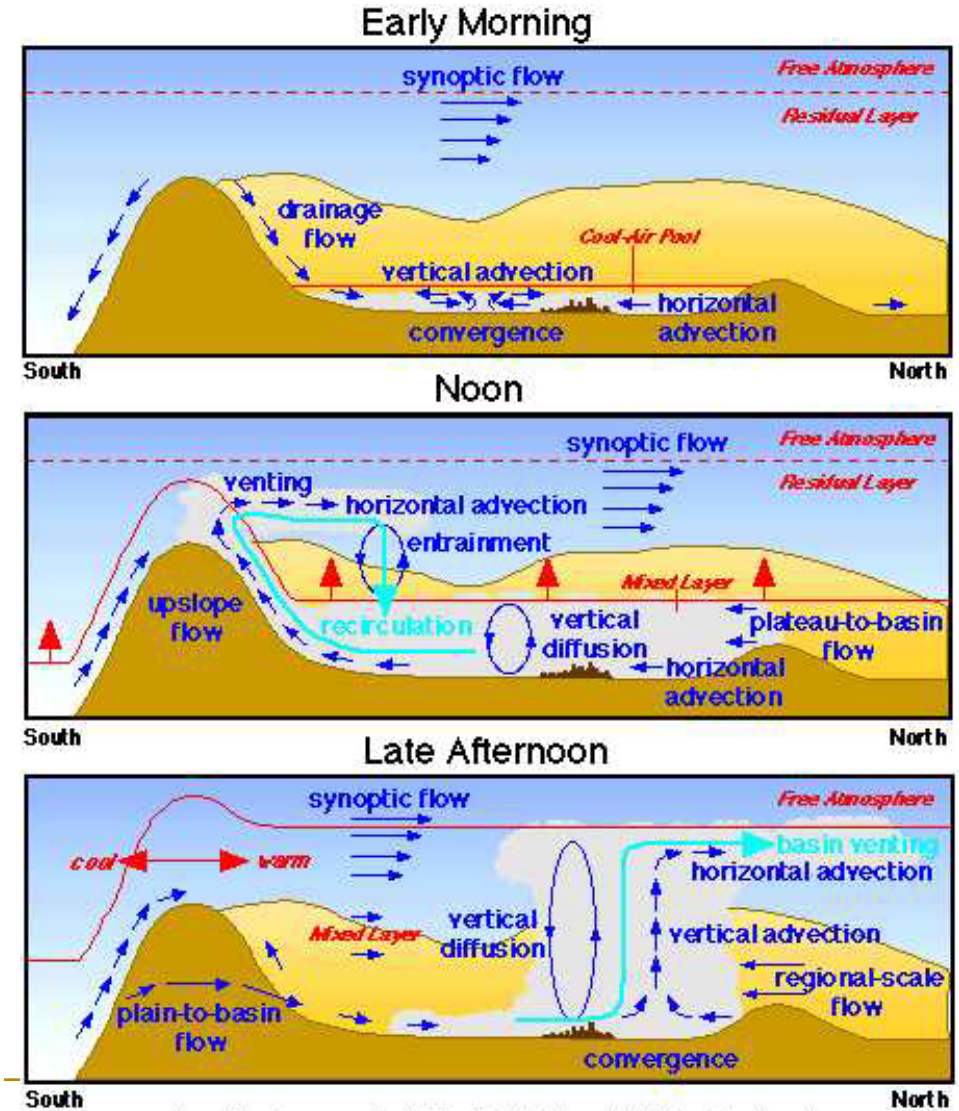
Fast NO to NO_2 Conversion & NH_4NO_3 Production

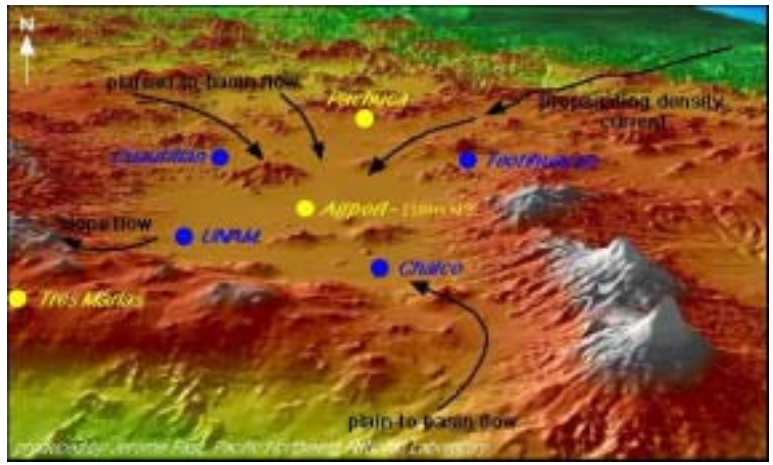
NH_3 Important!

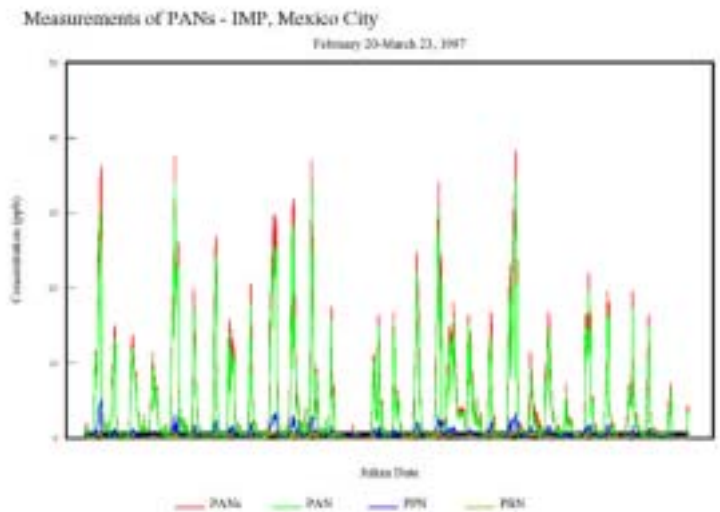
NH_3 Sources?

Mexico City 7:50 am 2/21/97

ASP METEOROLOGY – SHOWED STRONG DIURNAL TRANSPORT IN MEXICO CITY BASIN! TYPICAL?







MEXICO CITY MEGACITY 2003 – APRIL

Collaborative Effort with MIT – Luisa and Mario Molina

Mexico City Metropolitan Area 2003 (MCMA) Study

NARSTO Effort

Preliminary Findings of Note:

High Levels of Black Carbon – *Not Washed Out in Rain Event!*

Important – Regional Climate Implications

Obtained Radiation Data as well as Comprehensive Aerosol and Gas Phase Data Sets

Aerosol Mass Spectrometers (Aerodyne)

DOAS, LIDAR, TDLAS, MFRSR instrumentation

High Levels of Ammonia – Anti-correlated with NH_4NO_3

New Cars – NH_3 Sources!

April 2003 Intensive Field Measurement Campaign

- Fixed Site Aerosol Mass Spectrometer (Aerodyne)
- Tall flux tower (Washington State University)
- UV-VIS DOAS (University of Heidelberg/MIT)
- LIDAR (University of Berlin/MIT)
- Tethered balloon (CENICA)
- Vertical atmospheric radiosondes (IMP/MIT)
- Fast GC with Luminol detection method - PAN, NOx
- Aethalometer - Black Carbon
- Tunable-diode laser system for NH_3
- VOC Canister sampling
- Fast GC with OLEFIN Detector- isobutene
- Nitroarenes (Arey, Atkinson, UCRiverside)
- Organic Carbon/Elemental Carbon (LBNL)
- MFRSR & Aerosol Characterization (PNNL)
- PTRMS/Aerosol Mass Spectrometer– VOCs (PNNL)

CENICA SUPER SITE

POOLING RESOURCES THROUGH COLLABORATIVE FIELD WORK!

MCMA 2003 – MIT/AERODYNE MOBILE LAB

SPATIAL INFORMATION

- **NH_3/HNO_3 /HONO/HCHO QC-TILDAS (Aerodyne)**
- **AEROSOL MS**
- **Chemiluminescent NOy instrument (MIT)**
- **PTR-MS (MSU)**
- **Real-time Canister/Cartridge Autosampler (WSU)**
- **PAN/NO_2**
- **AETHALOMETER (LBNL)**

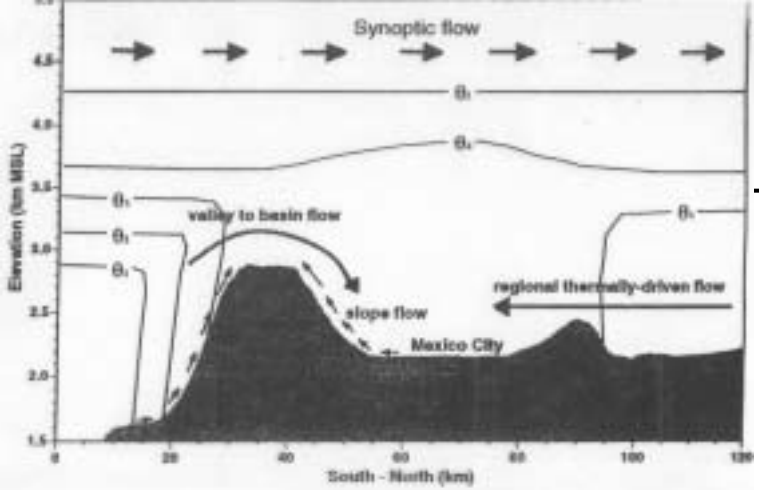


Figure 2. Schematic diagram of possible contributions to local flow patterns in the Mexico City area.

ASP Meteorologists

Showed Regional

"Flushing" of Basin

In Mexico City 1997 Study .

LIDAR AND AEROSOL DATA – BC, SULFATE, NITRATE, NH_3

Single Particle Mass Spectrometers, DOAS, etc.

→Daily Flux Estimates of the Mexico City Plume!

→Comparison to Modeled Emissions

MEXICO CITY MEGACITY 2006

PLANNING INITIATED FOR JOINT AIRCRAFT
& GROUND BASED STUDY
COLLABORATION WITH
MCMA 2006 – MIT
MIRAGE 2006 – NSF
INTEX B - NASA

SOME FOCUS AREAS

DETAILED CHARACTERIZATION OF A MEGACITY PLUME

INTEGRATED AEROSOL SOURCE STRENGTHS FROM A MEGACITY – FOR MODEL COMPARISON

DOE G-1, NSF C-130, and NASA DC-8 Aircraft

ASP INFRASTRUCTURE (RASS, SODARS, LIDARS, MFRSRs)

Ground Based Measurements (Two or Three Sites)

SECONDARY AEROSOL FORMATION & AGING – DOWNWIND PLUME MEASUREMENTS – BLACK CARBON, ETC.

NIGHTTIME RADIATIVE FORCING – "SMUDGE POT" EFFECTS (Jacobsen 2002) – GROUND BASED MEASUREMENTS.

MEXICO CITY – MEGACITY 2003

Molinas/Aerodyne/ANL
PNNL/BNL
NSF – MIRAGE COLLABORATION
NASA – DC-8 and Satellite Focus
Others?

Proposed Mexico City Campaign Winter-Spring 2006
PNNL/BNL and others

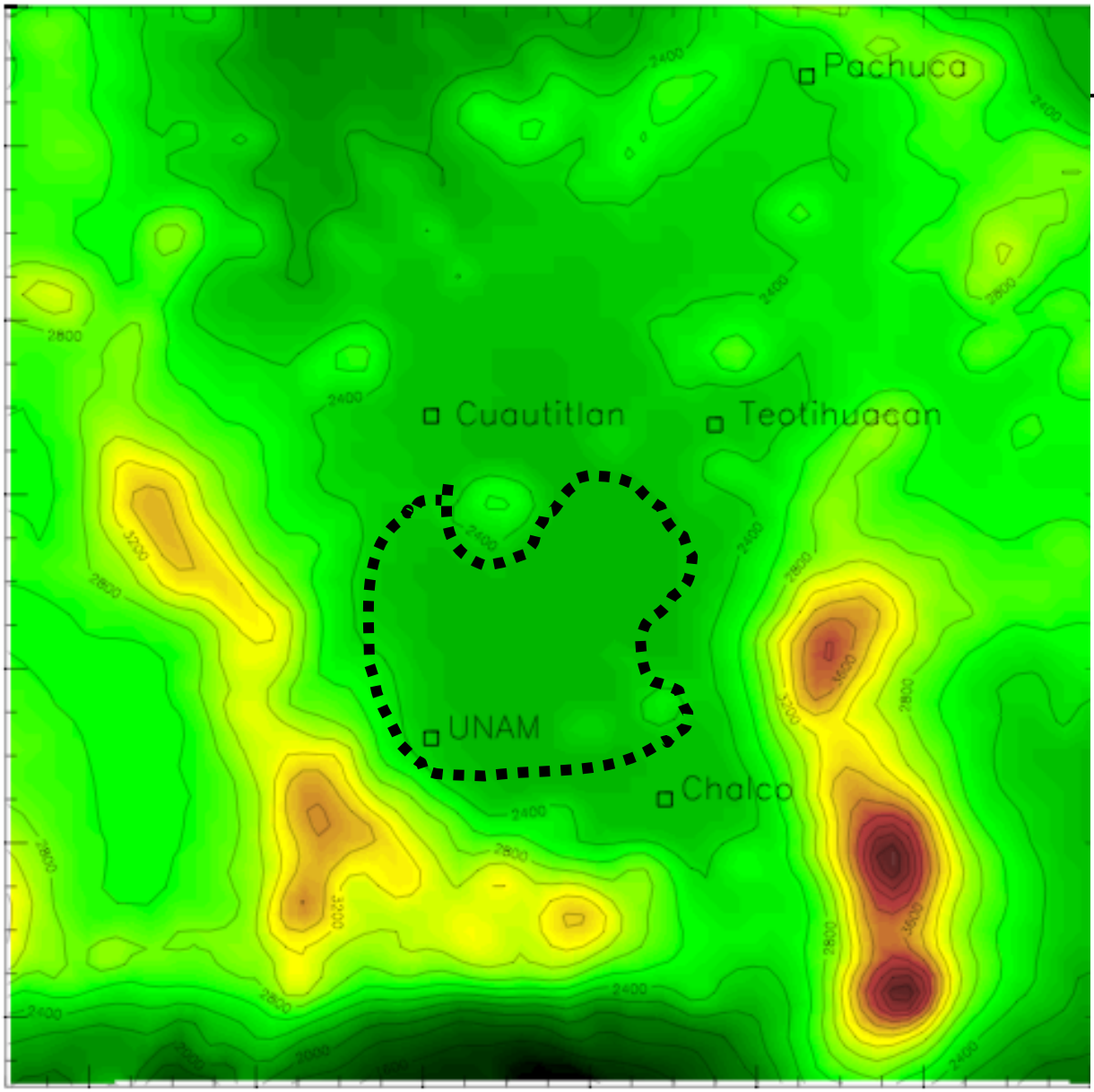
Chris Doran, Larry Kleinman, Jim Barnard

Objective:

To study the evolution of the specific absorption of black carbon and the chemical and meteorological processes that affect it.

Field Approach:

Measure optical and chemical properties of aerosols at two sites downwind from Mexico City, with travel times t_1 and t_2, at the surface and aloft.


Pachuca
Cuautitlan
Teotihuacan
UNAM
Chalco
2400
2800
3200
3600

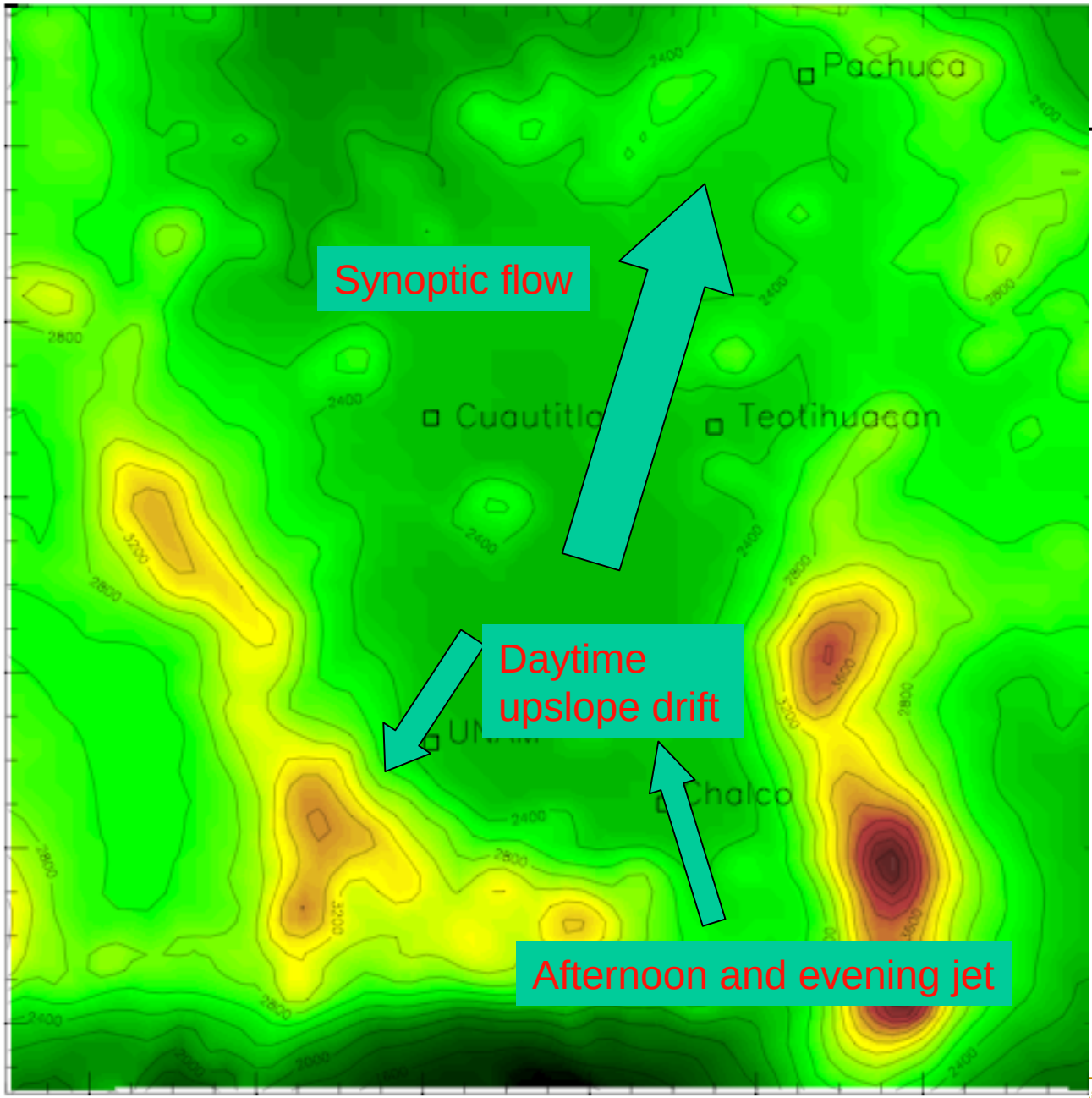
20

19

-99.6

-98.6

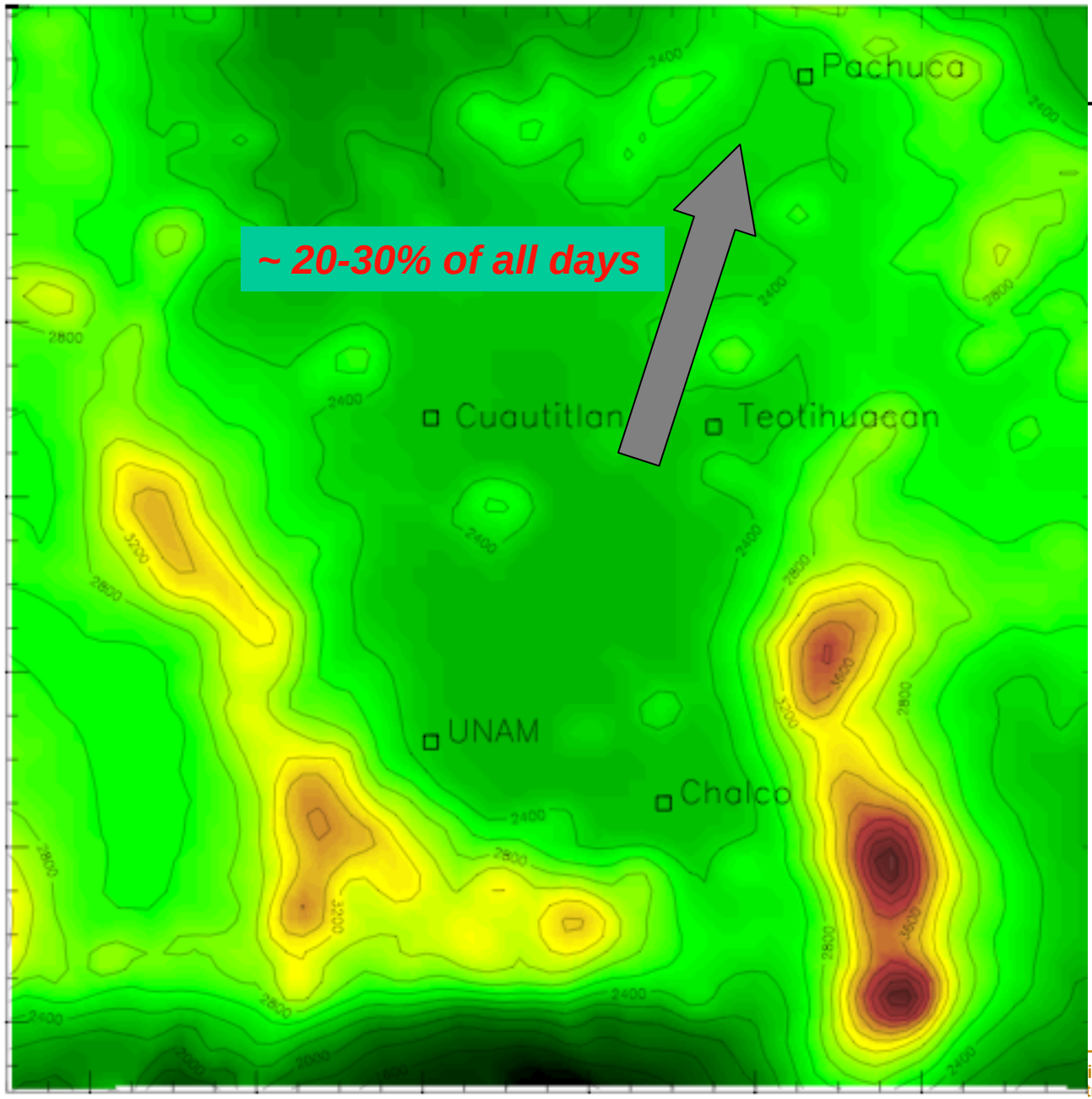
20


Pachuca
Cuautitlá
Teotihuacan
Chalco
Synoptic flow
Daytime
upslope drift
Afternoon and evening jet
2400
2800
3200

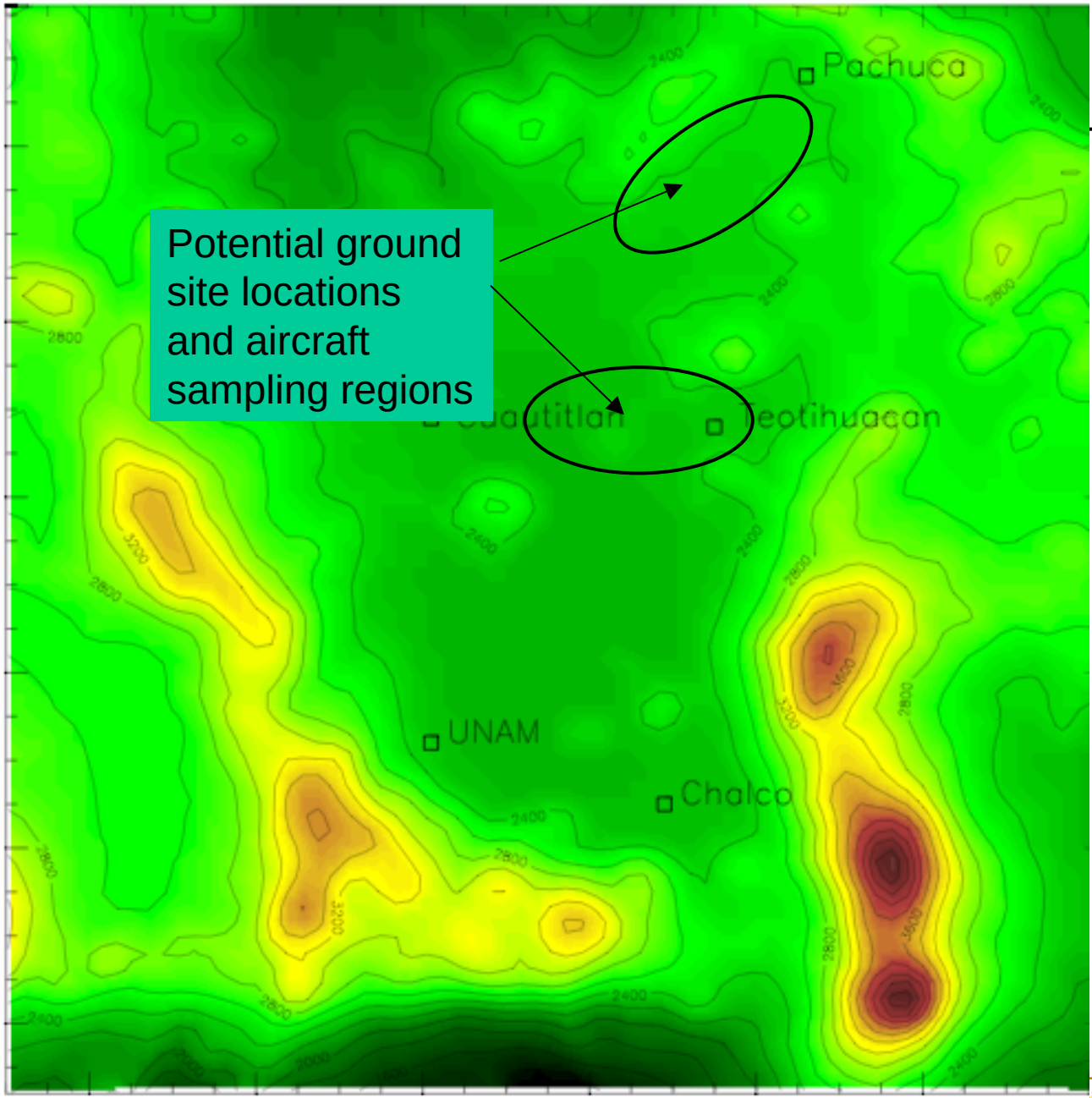
19

-99.6 -98.6

20


Pachuca
~ 20-30% of all days
Cuautitlan
Teotihuacan
UNAM
Chalco
2400
2800
3200
3600
-99.6
-98.6

19


Potential ground site locations and aircraft sampling regions
Pachuca
Teotihuacan
UNAM
Chalco
2400
2800
3200
3600

Invitation:

Investigators wishing to deploy instruments at one or both ground sites, whether to look at aerosol aging or for other purposes, are welcome. We will try to accommodate as many interested groups as possible.

LOTS TO BE DONE

IDENTIFY SCIENCE TO BE DONE
- **EQUIPMENT NEEDS**

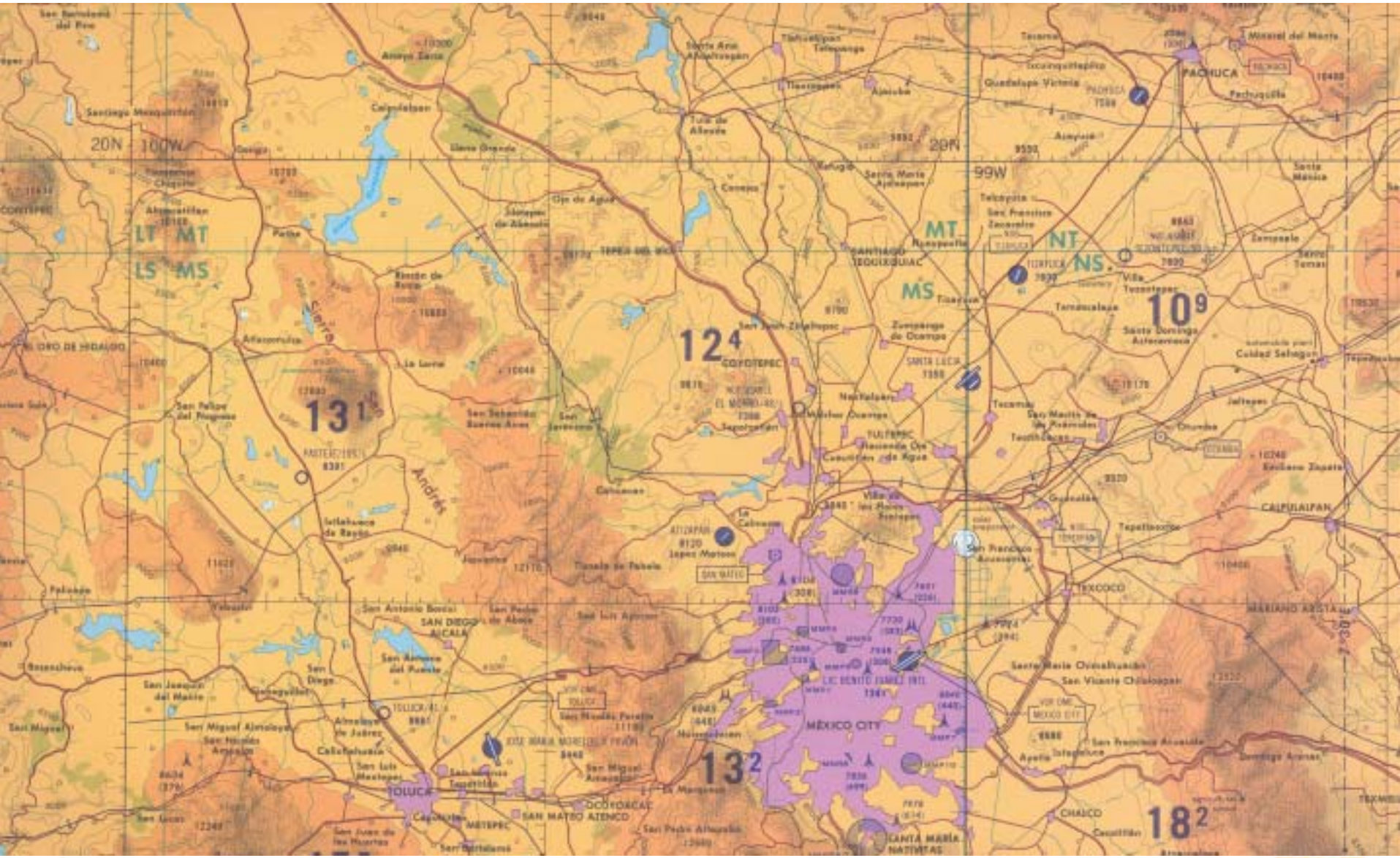
GROUND BASED SITES

AIRCRAFT OPERATION- FLIGHT PLANS/AIRPORTS

PERMITS FOR RESEARCH IN MEXICO
- **EQUIPMENT LISTS FOR IMPORT INTO MEXICO**

COORDINATION WITH NSF AND NASA

OTHERS


20N
100W
99W
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PACHUCA
TOLUCA
MÉXICO CITY
TEXCOCO
CALPULALPAN
CHALCO
SAN MATEO ATENCO
13 1
12 4
13 2
10 9
18 2